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# COMPARATIVE MINERALOGY OF THE TULKS DEPOSIT AND A MASSIVE SULPHIDE ERRATIC FROM THE LLOYD'S RIVER VALLEY, BUCHANS AREA, NEWFOUNDLAND

by

J.L. Jambor*

## ABSTRACT

Massive sulphide boulders of undetermined source occur at a site along the Lloyd's River Valley southwest of Buchans. A piece from the largest boulder, which weighs about 5 tonnes, was examined mineralogically and was found to consist mainly of pyrite and sphalerite with abundant but lesser amounts of galena, and small amounts of chalcopyrite; other minerals present are arsenopyrite, tetrahedrite, stannite, aurian silver, covellite, digenite, and anglesite. The principal non-sulphide mineral is quartz which is accompanied by muscovite and chlorite. All of the minerals in the boulder also occur in the Tulks massive sulphide assemblage, but a few significant differences in textures and mineral compositions are present. Most notable are the presence of growth-zoned pyrite only in the boulder, and the presence of tetrahedrite with compositions which markedly differ from those in the Tulks deposit. As well, the iron contents of sphalerite from the boulder are slightly but anomalously higher than those of Tulks sphalerite. These and other minor features suggest that the erratics were derived from a massive sulphide source other than the Tulks deposit.

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# ÉTUDE MINÉRALOGIQUE COMPARATIVE DU GISEMENT DE TULKS ET D'UN GÎTE DE SULFURES MASSIFS ERRATIQUES DE LA VALLÉE DE LLOYD'S RIVER DANS LA RÉGION DE BUCHANS, TERRE-NEUVE

par

J.L. Jambor*

## RÉSUMÉ

Des blocs de sulfures massifs provenant de source indéterminée se trouvent le long de la Vallée de Lloyd's River au sud-est de Buchans. On a réalisé une étude minéralogique d'un morceau pesant environ 5 tonnes, provenant du plus gros bloc de roches; il contenait principalement de la pyrite et de la sphalérite avec des quantités moindres mais abondantes de galène et de petites quantités de chalcopyrite; les autres minéraux présents étaient l'arsénopyrite, la tétrahédrite, la stannine, la covelline, la digénite, l'anglésite et de l'argent aurifère. Un des principaux minéraux non-sulfurés découvert était le quartz accompagné de muscovite et de chlorite. Tous les minéraux contenus dans le bloc de roches se retrouvent dans l'assemblage de sulfures massifs du gisement de Tulks, mais on a toutefois observé quelques différences importantes dans la texture et la composition minérale de certains minéraux. Parmi les plus importantes, on a remarqué la présence de pyrite de zone d'accroissement dans le bloc de roches seulement et de la tétrahédrite dont la composition diffère beaucoup de celle du gisement de Tulks. De même, la teneur en fer de la sphalérite contenue dans le bloc de roches est un peu mais anormalement élevée par rapport à la teneur mesurée dans la sphalérite provenant du gisement de Tulks. Ces données ainsi que d'autres aspects suggèrent que les erratiques ont été dérivés d'une source de sulfures massifs autre que le gisement de Tulks.

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# INTRODUCTION

Mineralogical work in the Buchans area of central Newfoundland was begun in the summer of 1982 as a CANMET contribution to the initial phase of a broader program of geological studies within the Canada-Newfoundland Mineral Development Agreements. The specific objective of the mineralogical work was to determine the character and distribution of the hydrothermal alteration associated with the reputedly in-situ Lucky Strike orebody at Buchans; documentation of the alteration features was considered important because of its potential practical applications, namely, as an aid in recognizing and comparing altered, or possible altered, rocks encountered in exploration drilling in other nearby areas. Since the inception of the mineralogical work, however, there have been major diversions involving the study of the Tulks and Tally Pond deposits (Fig. 1) as these were considered as potential sources of feed which would prolong the operation of the now-closed Buchans mill.

## Sulphide boulders

During road building along the Lloyd's River Valley in 1975, a boulder weighing about 5 tonnes and consisting wholly of massive sulphides was exposed by a bulldozer preparing the road cut (Fig. 1). As well, several oval massive sulphide boulders up to 0.3 m in longest dimension, and several fist-sized boulders were found. The boulders are glacial debris, and as glacial movement had been southwesterly along Lloyd's River Valley (Prest et al. 1970), the source of the debris was most likely in the

direction of Red Indian Lake (Fig. 1). Of the massive sulphide deposits known in the area, the closest to the boulder site and inferred source is the Tulks prospect (Fig. 1). Dr. J.G. Thurlow of Abitibi-Price Mineral Resources Division at Buchans pointed out that any information which would lessen the possibility that Tulks was the sulphide source would be valuable in an exploration context because of the concomitant enhancement of the possibility of an undiscovered sulphide body; the writer's familiarity with the character of the Tulks massive sulphides (Jambor 1984) therefore would be extremely useful in making comparisons with the boulder sulphides and interpreting the results.

## SAMPLE DESCRIPTION AND PREPARATION

A piece removed from the largest sulphide boulder was examined mineralogically. The piece had been cut with a diamond saw by Dr. Thurlow to yield a flat surface approximately 15x15 cm. Opposite the sawn face is the convex weathered surface of the boulder, a small part of which is covered by a thin scale of goethite and iron oxides. The thickness of the sulphide slab averages roughly about 5 cm. Layering of the sulphides is conspicuous both on the sawn and weathered surfaces, and arises principally from the alternation of sphalerite-rich and pyrite-rich layers. The sphalerite-rich layers are medium brown and mostly 1 to 2 cm thick. Scattered galena is evident, and chalcopyrite is commonly visible in the pyrite-rich layers. The sulphides are well-crystallized, and sphalerite has attained sufficient coarseness to appear to be sucrose. The pyrite-rich layers are finer grained than those of sphalerite; the coarsest pyrite consists of abundant scattered cubes up to 1 mm along an edge.

Seven polished sections were prepared from material cut perpendicular to the layering to give a relatively complete cross-section of the specimen. Three thin sections also were prepared from material cut normal to the sulphide layering: two of the sections consist of typical massive sulphides; the third was chosen to represent the most silicate-rich part of the specimen and contains about 50% sulphides.

## RESULTS

The megascopic preponderance of sphalerite and pyrite also is evident microscopically. The sphalerite-rich layers consist of coarse, homogeneous sphalerite containing numerous patches of coarse-grained galena and scattered grains of corroded pyrite. Microprobe analyses of the sphalerite confirm that its brown colour reflects a low iron content (Table 1). None of the sphalerite contains emulsion-texture or exsolution-type blebs of chalcopyrite. In pyrite-rich layers the sphalerite is either interstitial to pyrite or is supplanted by galena and/or quartz.

Pyrite is present both as coarse and fine grains which occasionally are in mutual contact. In sphalerite-rich layers most of the pyrite occurs as remnants of relatively coarse crystals, many with corroded smooth outlines (Fig. 2). Pyrite-rich layers consist of aggregates of pyrite grains which are generally euhedral to subhedral; these are variable in size from rare grains less than 5 micrometers along an edge, to numerous grains 0.3 mm to 1.0 mm along an edge. Coexistence of grains at the opposite extremes of the size range is rare, and the norm is to have

segregation into crude layers in which the pyrite sizes are somewhat restricted. Compact masses of pyrite also are uncommon; usually the individual pyrite grains of aggregates are partly separated by galena or quartz. The prevalence of galena and paucity of sphalerite as interstitial sulphides is a noticeable feature in the sections.

Large pyrite grains riddled with bleb inclusions of galena, sphalerite, and quartz are common. Etching with nitric acid shows that many apparently homogeneous pyrite grains are growth-zoned or have a wide, single overgrowth rim. In all but the finest grains the growth zones are poorly developed or diffuse rather than sharply defined, though rare exceptions which include colloform textures have been noted. Growth zoning in the finer pyrite grains is more common and the zones have better definition than in coarse grains. A few relict framboids of pyrite isolated in quartz have been observed; in all of these the constituent pyrite has undergone recrystallization to fewer and larger grains than are present in unmetamorphosed framboids.

Galena is abundant in all of the sections, occurring chiefly as large grains of irregular outline in sphalerite (Fig. 2) and as finer grains interstitial to pyrite (Fig. 3). As has been noted above, the pyrite-rich layers of the boulder contain abundant galena and comparatively sparse sphalerite. Chalcopyrite, which is exceedingly meager relative to galena and sphalerite, also has a distinct affinity with pyrite and is virtually absent in the sphalerite-rich layers.

Tetrahedrite is widely distributed in the specimen as is indicated by occurrences in five of the seven polished sections. Usually several grains, typically in smooth-bounded contact with galena, occur in a section. The largest grain observed is about 60 micrometres in diameter, but most are 5 to 25 micrometres and thus their total volume percentage is small. Microprobe analyses of three grains from three polished sections representative of a fairly complete cross-section of the boulder are given in Table 2.

Arsenopyrite also is common but, like tetrahedrite, makes up only a low fraction of a per cent of the volume of sulphides. The arsenopyrite occurs as subhedral to anhedral grains which commonly have corroded margins and which are sporadically distributed amongst pyrite; the two minerals are closely associated and are similar in grain size.

Several minute stannite blebs, 5 micrometres and less in diameter, occur as inclusions in sphalerite in one polished section. Qualitative energy dispersion analyses showed that kesterite is absent and the zinc content of the stannite is extremely low.

Two grains of "electrum", one about 5 micrometres in diameter and the other about 5x10 micrometres, were observed in different polished sections. Microprobe analysis of one grain gave a formula ratio of $Ag_{0.64}Au_{0.36}$, and the other gave $Ag_{57}Au_{43}$; therefore, both grains are aurian silver.

The principal gangue mineral is quartz which is accompanied by small amounts of fine-gained muscovite and chlorite, and by a few grains of rutile. Covellite and digenite are common in one polished section; many

galena grains have a microscopically faintly speckled appearance and grey, corroded margins which are characteristic of alteration to anglesite. In the silicate-rich thin section, well-crystallized grains of anglesite occur in patches up to 0.05x0.25 mm.

## COMPARISON WITH TULKS MASSIVE SULPHIDES

It is virtually redundant to state that incontrovertible conclusions about sources cannot be made on the basis of a mineralogical examination of a fragment from a single erratic. It was known at the beginning of the study that a specific rather than nebulous conclusion would be especially difficult in this case because the massive sulphide boulder and the Tulks sulphides have megascopically obvious mineralogical similarities; thus, mineralogical differences, if present, were expected to be subtle rather than drastic. The general likeness of the two mineral suites was assumed to mean only that the source of the erratics was either Tulks or another deposit having a similar mineral assemblage. It is also necessary to assume that the glacially eroded parts of the Tulks deposit did not differ significantly from the uneroded remainder.

The microscopic study has confirmed the megascopic resemblance in sulphide assemblages in that all of the minerals noted in the boulder also occur at Tulks. The overall impression is that sulphide textures in the boulder differ somewhat from those at Tulks, but little weight can be given to this aspect because the textural variations might be only local features. There are, however, some specific differences which are considered to be significant as noted below:

1. Arsenopyrite grains in the boulder are dispersed and are typically non-euhedral. Tulks arsenopyrite differs in that most occurs as euhedral to subhedral crystals and crystals clusters, or as fine-grained clouds aggregated in sphalerite.
2. The range in pyrite grain sizes in the boulder is too large to be definitive, but pyrite grains in the boulder commonly show growth zoning whereas Tulks pyrite characteristically lacks this feature. The presence of growth zones indicates that metamorphic recrystallization has not been complete and suggests, therefore, that the boulder sulphides were derived from a site less strongly metamorphosed than the Tulks deposit.
3. Four analyses of sphalerite from the boulder zone gave Fe contents ranging from 4.2 to 5.0 wt %. Five analyses of sphalerite from the Tulks T-3 lens gave a range of 1.8 to 4.2 wt % Fe, and an average of 2.7 wt % Fe (Jambor 1984). Although the difference in compositions is not large, the higher iron content of the boulder sphalerite is distinctly anomalous relative to that of Tulks sphalerite.
4. Compositions of aurian silver from the boulder differ from those of gold in the Tulks T-3 lens. The aurian silver from the boulder is similar to that from the Tulks T-1 lens.
5. Compositions of tetrahedrite are completely unlike any from the Tulks sulphide lenses. Especially notable are the high antimony and correspondingly low arsenic contents, and the extremely high silver percentages in tetrahedrite from the boulder.

## CONCLUSIONS

Microscopic examination has shown that the boulder from the Lloyd's River Valley has a sulphide assemblage similar to that of the Tulks deposit. There are, however, subtle textural differences, the most notable being that only pyrite from the boulder has abundant growth zoning. Iron contents of the boulder sphalerite are slightly but anomalously higher than those of Tulks sphalerite, and compositions of tetrahedrite differ radically. These features suggest that the Tulks deposit was not the source of the glacial erratics; the results therefore support the possibility that either the mineralogically unexamined Tulks East deposit was the source, or that an undiscovered massive sulphide body is present in the vicinity of the southern end of Red Indian Lake.

## ACKNOWLEDGMENTS

Dr. J.G. Thurlow of Abitibi-Price Mineral Resources Division suggested the study, and provided the specimen and relevant information. Technical assistance at CANMET was kindly given by P. Carriere (microprobe analyses) and by J.J.Y. Bourgoin and J.M. Beaulne (lapidary).

## REFERENCES

Jambor, J.L. "Mineralogy of the Tulks Zn-Pb-Cu massive sulphide deposit, Buchans area, Newfoundland"; Division Report MRP/MSL 84-22 (TR); CANMET, Energy, Mines and Resources Canada; 1984.

Prest, V.K., Grant, D.R. and Rampton, V.N. "Geological Survey of Canada Map 1253A", In: Geology and Economic Minerals of Canada; edited by R.J.W. Douglas; Geological Survey of Canada Economic Geology Report No. 1; 1970.

Table 1. Microprobe compositions of sphalerite

| | Polished section | LR-1 area 1* | LR-2 area 2 | LR-4 | LR-6 |
|---|---|---|---|---|---|
| wt % | Zn | 63.2 | 63.5 | 61.2 | 62.0 |
| | Fe | 5.0 | 4.6 | 4.7 | 4.2 |
| | Cd | 0.1 | 0.1 | 0.2 | 0.2 |
| | Mn | 0.1 | 0.1 | 0.1 | 0.2 |
| | S | 33.6 | 33.2 | 32.8 | 33.2 |
| | | 102.0 | 101.5 | 99.0 | 99.8 |

*Inclusion in pyrite; all other grains represent sphalerite grains distant from pyrite.

Table 2. Microprobe compositions of tetrahedrite

| | Polished section | LR-1 | LR-4 area 1 | LR-4 area 2 | LR-6 |
|---|---|---|---|---|---|
| wt % | Cu | 23.5 | 22.7 | 22.8 | 25.5 |
| | Fe | 4.5 | 5.0 | 5.1 | 5.5 |
| | Ag* | 19.2 | 18.2 | 21.4 | 17.8 |
| | Zn | 1.4 | 4.1 | 1.7 | 1.8 |
| | As | 0.7 | 0.6 | 0.5 | 0.4 |
| | Sb | 27.4 | 26.0 | 26.9 | 27.2 |
| | S | 23.6 | 23.4 | 22.6 | 22.9 |
| | | 100.3 | 100.0 | 101.0 | 101.1 |

*The maximum Ag content found in Tulks tetrahedrite-tennantite was 12.3 wt %, and most grains contained substantially lower Ag values.

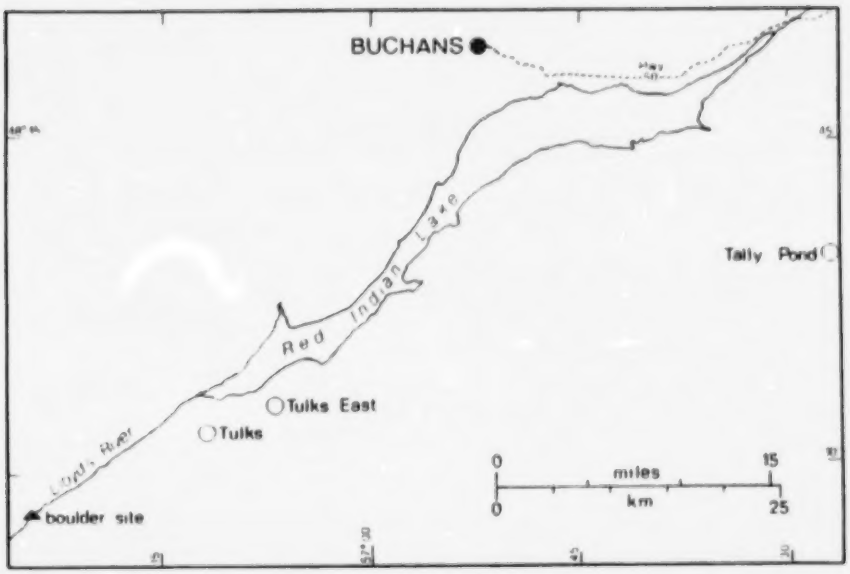


Fig. 1 - Location of the Tulks deposit and discovery site of the Lloyd's River massive sulphide erratics.

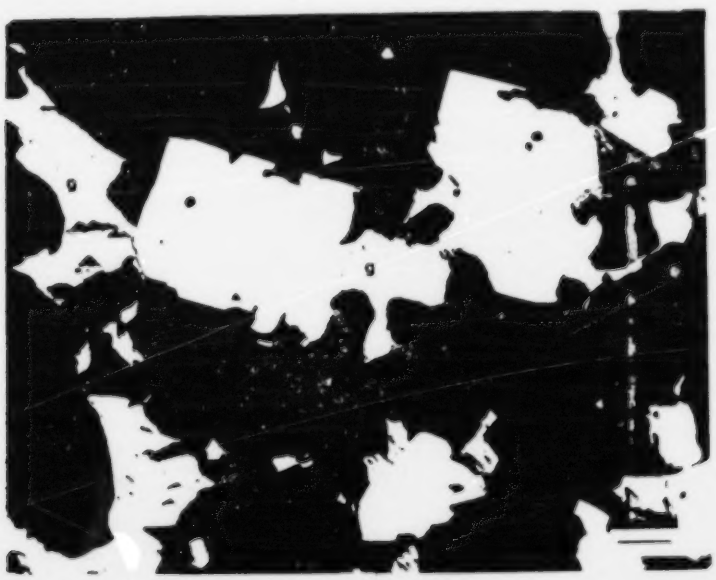


Fig. 2 - Typical habits of galena (g, with triangular pits) and large, corroded crystals of pyrite (white) in a grey groundmass of homogeneous massive shalerite. Reflected light, air. Bar scale represents 0.10 mm.

Fig. 3 - Pyrite in euhedral crystals (white) and in finer grained aggregates (centre) containing abundant light grey interstitial galena. Reflected light, air. Bar scale represents 0.10 mm.